Summary of PHENIX Drift Chamber West repair in July-August 2010

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DC repair goals

During the 2010 shutdown, PHENIX had an unique opportunity to repair some parts of the detectors and electronics that were not accessible during all 10 years of operation. This was due to the beam pipe removal and all 4 arms being separated.

The drift chambers accumulated 3 sets of problems: broken wires during Run10, some very old High Voltage and electronics problems. As a result, significant portions of the central arm acceptance were lost. Most critical, in this sense, was the status of DC West. Due to time constraints and the complex procedure of supplying gas and power to DC East while it is stationed in the assembly hall, there were no repairs performed on DC East.

The major plan for repair

The DC contains 20 sectors in azimuth, 90º/20=4.5º/sector. Each sector is formed by 4 signal planes (nets). Readout electronics are located on north and south sides. If there is a problem in the electronics, the particular sector should be partially disassembled and problematic signal board should be sent to Stony Brook for repair and testing. If a high voltage problem exists in a sector, then the problem is most likely a result of one of the four signal planes, within the problematic sector, inability to hold HV. This repair would require complete disassembly of electronics in one end of the particular sector, find the troublemaker plane and disconnect it completely from HV power supply. Thus, 1 out of 4 boards will be lost, but the remaining 3 can be restored to the nominal regime. To locate the bad nets, we used non-flammable gas mixture Ar/CO2 = 85/15 with HV regime with close to working gas nominal conditions at similar HV.

Status of the west chamber at the end of Run 10

Fig. 1 shows an example of the online monitoring output near the end of Run 10. There were six non-working modules in X1 section: sectors 2, 10, 11, 14, 15, 16; three bad modules existed in X2 sectors: 9, 10, 12. These issues were mostly the result of HV problems and broken wires inside the chamber. Shorts induced by broken wires are highlighted in red in Fig. 2. HV problems were accumulated over the 10 year period of operation, such as the cathode problem in sector X1_5 and weakness in other HV potentials in sectors X2_6, X2_8, X2_9, X2_12, X2_14. Fig. 3 displays the cards from the DC electronics that have a problem. In total we had ~38% loss for tracks with quality 63 (track reconstructed in X1 and X2 planes).

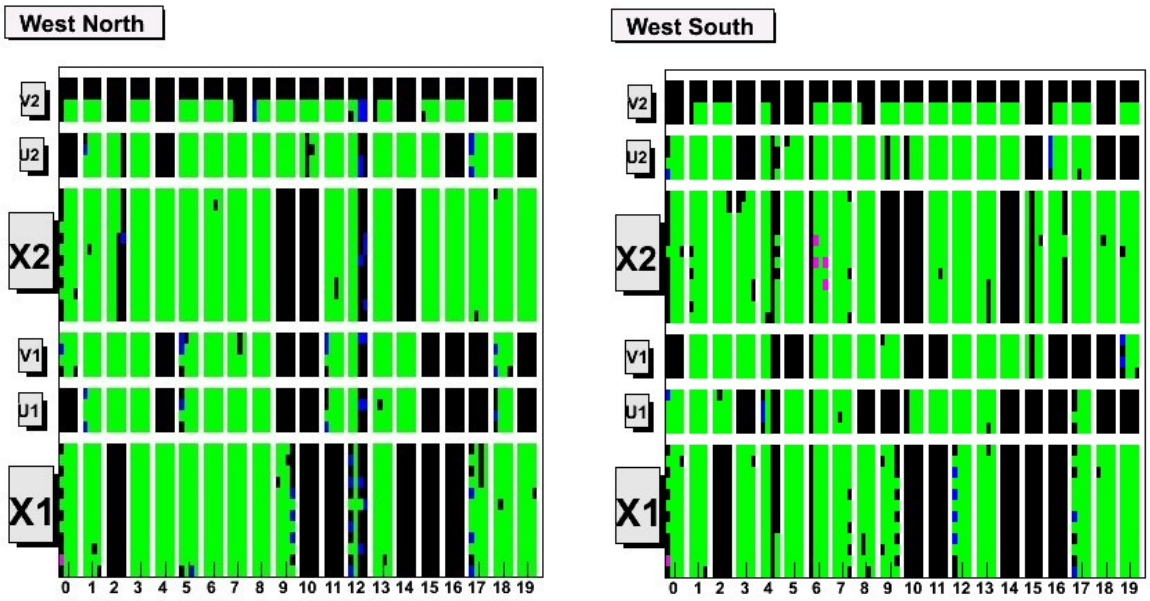

Fig.1. Online monitoring page at the end of Run 10.

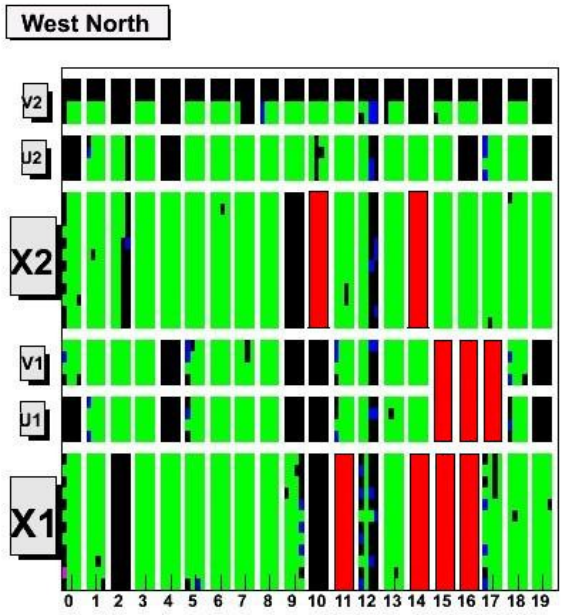

Fig.2. Shorts induced by broken wires indicated in red.

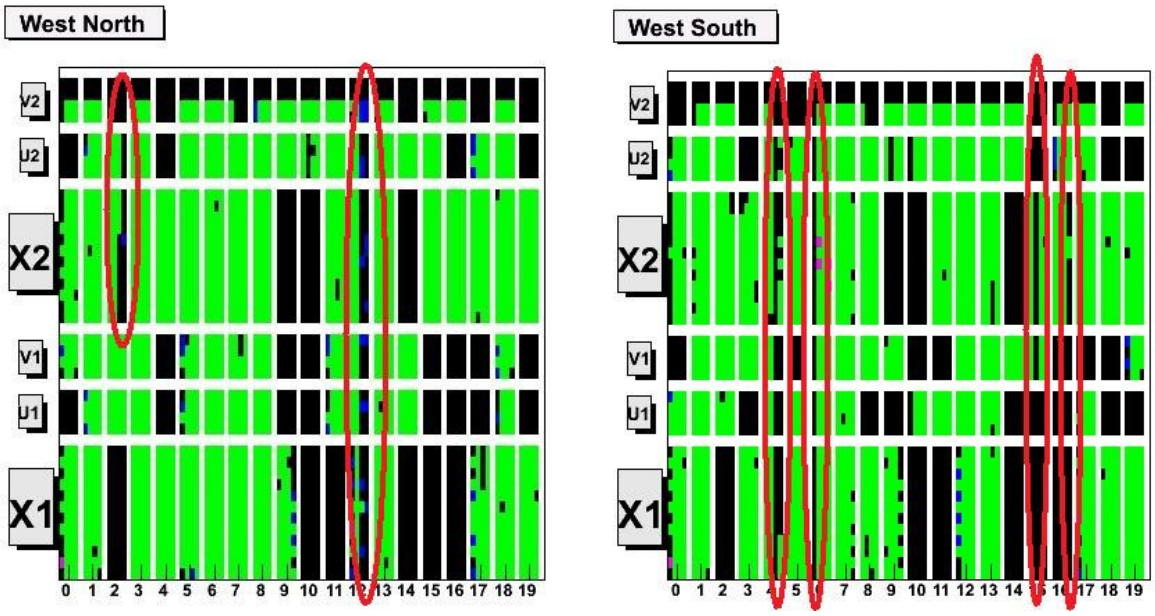

Fig.3 Problems with electronics

Repairs Performed

1. **Removal of broken wires.** The following three broken wires were removed (nets are numbered from the bottom in each sector):
   1. *X2_14_2 - Termination wire (at large radius).*
   2. *X1_11_3 Gate wire.*
   3. *U1_16_2 Termination wire.*

2. **Disconnection of weak nets from HV power supply:**
   1. *5X1_2_C (second Cathode net from the bottom in sector 5X1)*
   2. *6X2_2_PGB (Potential, Gate and Back wires were disconnected)*
   3. *8X2_3_PGB(the same). Here we also fixed HV contact - cold soldering*
   4. *9X2_3_C*
   5. *9X2_4_C (small cathode near Strut)*
   6. *10X2_2_PGB*
   7. *14X2_2_PGB*

HV problem in sector X1_2, which was developed during the Run 10, did not show up in August. Thus, no repair was attempted on this sector.

HV test after repair:

Non-flammable gas mixture Ar/CO2 85/15. All sectors set at the same HV regime identical to nominal working conditions. During an eight-hour test there were 3 random trips (not

correlated with repaired sectors), which could be attributed to the fact that a less stable gas mixture was utilized, specifically with 15% CO2 instead of 50% C2H6 (Ethane). In Fig.5 we show disconnected nets. Total loss from HV is 7/80=8.75% of the West acceptance (at the end of Run 10 was 38%).

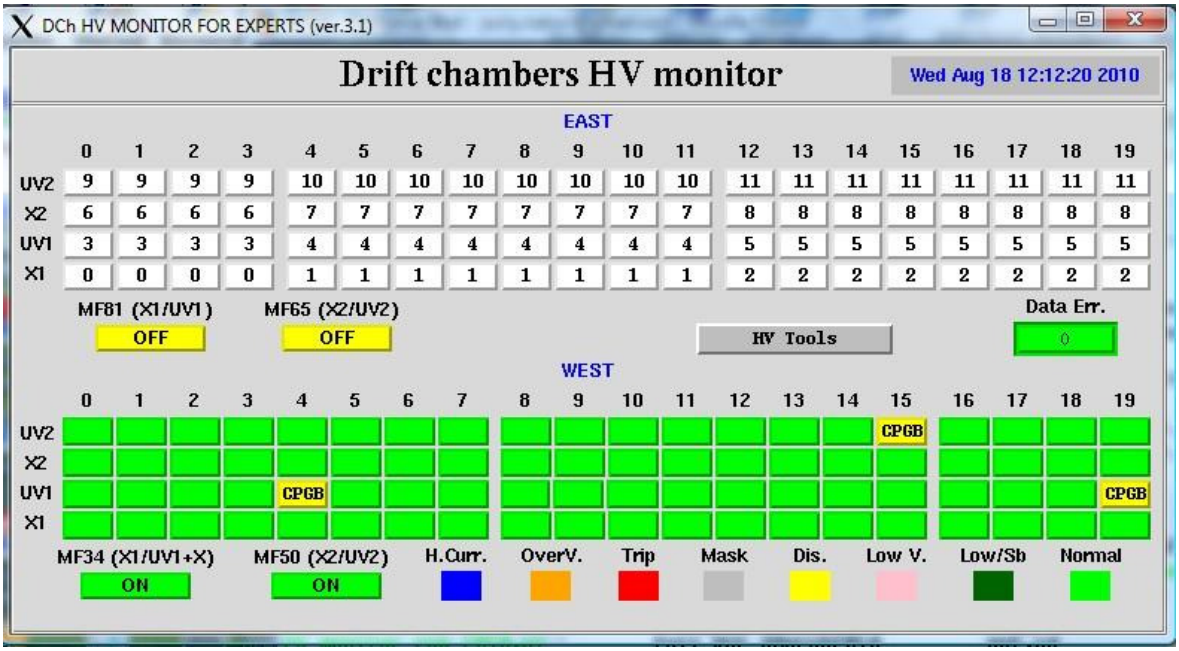

Fig. 4. Online HV monitor after repair

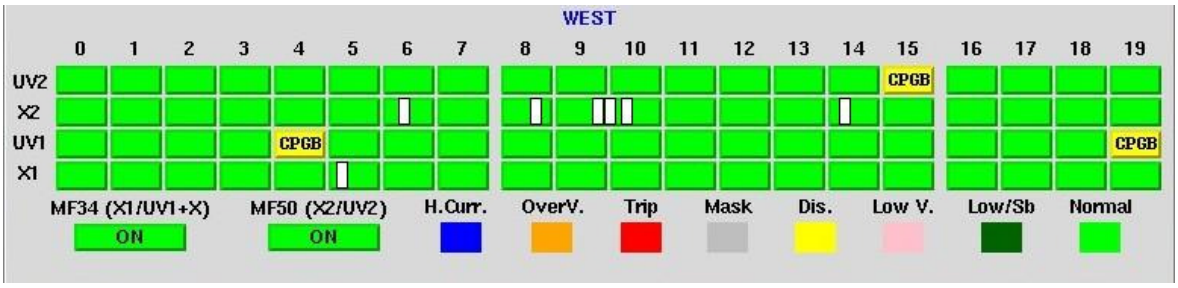

Fig.5. Location of disconnected nets are overlaid onto Fig. 4.

3. **Board removal and repair:** The following boards were removed and sent to Stony Brook for testing and repair (numbering from the bottom)**:**

   (North or South sector #, see also Fig.3)

   1. N2 → board 3, 4
   2. S6 → board 1
   3. S4 → board 3, 4
   4. N12 → board 3, 4

5. S16 → board 4
6. S15 → board 2

In cases 1 and 4 no problems were identified during the tests at Stony Brook, thus we put these boards back to the chamber without any fix (unfortunately problems were still there as we found during the final tests on the chamber, see below). For the remaining cases, work was performed on the boards at Stony Brook.

Electronics test after repair:

A very low registration threshold of 3 fC (nominal is 5-6 fC) was set for all electronics channels, as seen in Fig. 6. Black color means that the channel is overflowed by noise. Other colors reflect spread of the RF noise. Thus, most of channels are alive.

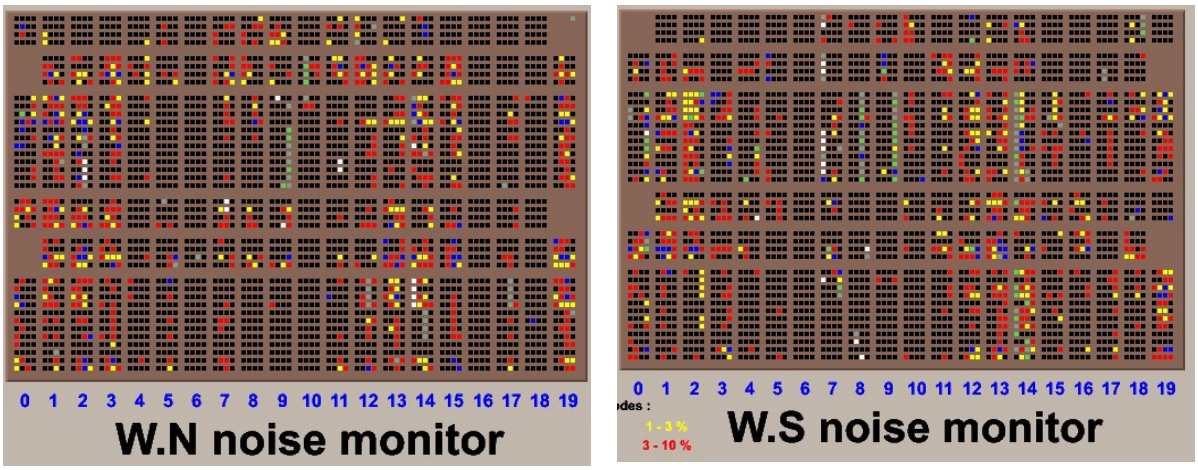

Fig. 6. Online monitoring at low 3 fC threshold

Fig. 7 is the result of setting the thresholds to values used during physics running. The remaining noisy channels (not gray) will be masked. There is also a strange pattern with increment +8 in south sector 15, board #2.

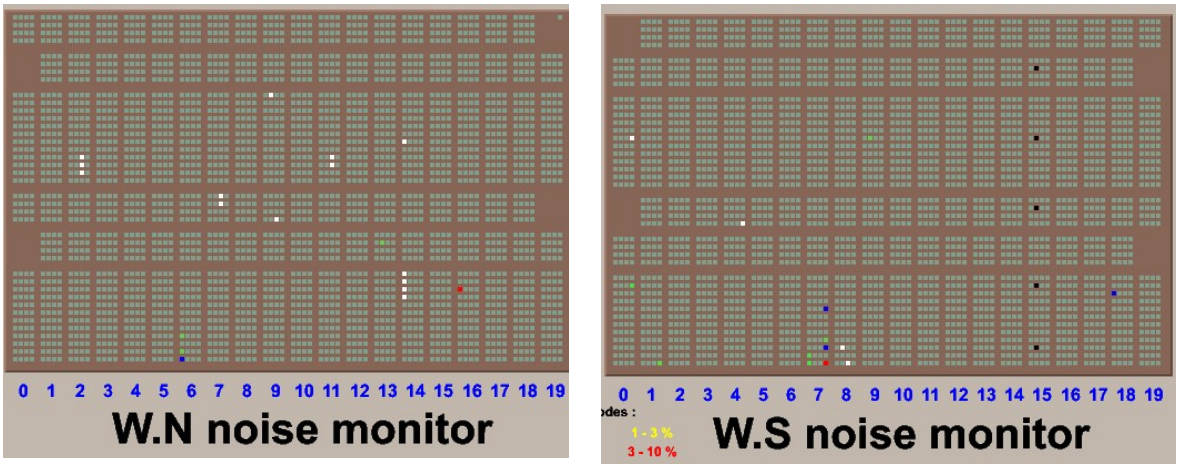

Fig. 7. Online monitoring with nominal thresholds.

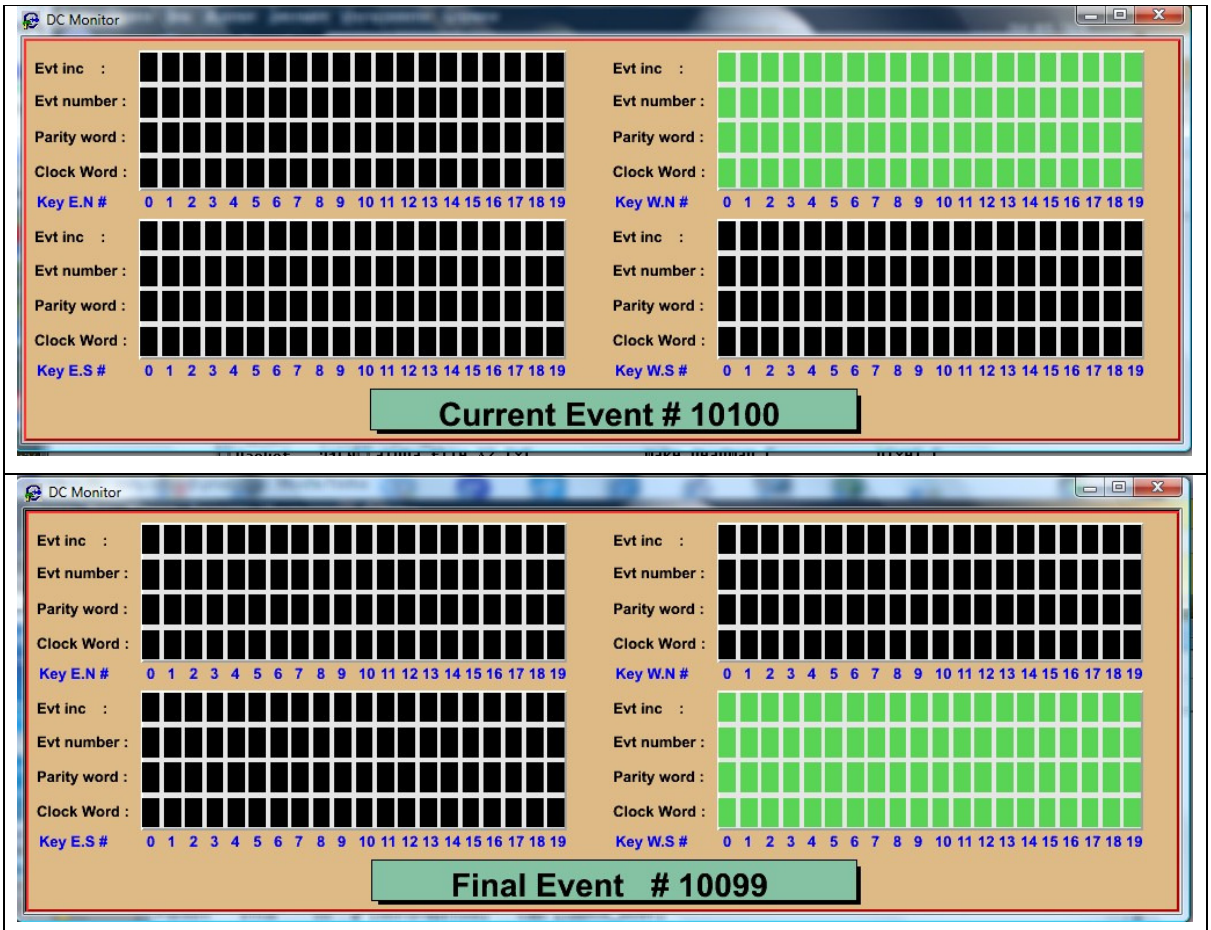

Fig. 8. Packet quality control. All look OK.

Internal format of the data packets is correct, see Fig. 8. Unfortunately, two problems with large packets (packet #3125 from North 12 and #3145 from North 2, which is equivalent to 4/80=5% of the West acceptance) were not fixed (see Table 1) while tabletop tests did not find any problems. There was no time for the second iteration to work on these boards. This unclear problem has persisted over the past 5 to 6 years and will need additional work performed before Run 11. TMC boards can also be removed by working from the ladder, in addition to a man lift.

Table 1. Data quality (Cris code)

[phnxrc@phoncsc ~]$ dlist -f $STANDALONE_DISK/junkdata/rc-0320828-DC.W-1.prdf
Packet 3113 27 0 (Unformatted) 503 (IDDCH_DCM1)
Packet 3114 24 0 (Unformatted) 503 (IDDCH_DCM1)
Packet 3115 30 0 (Unformatted) 503 (IDDCH_DCM1)
Packet 3116 21 0 (Unformatted) 503 (IDDCH_DCM1)
Packet 3117 21 0 (Unformatted) 503 (IDDCH_DCM1)
Packet 3118 20 0 (Unformatted) 503 (IDDCH_DCM1)
Packet 3107 20 0 (Unformatted) 503 (IDDCH_DCM1)

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Packet   3110    20  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3111    39  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3097    61  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3098    34  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3099    40  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3100    29  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3089    36  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3090    33  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3091    50  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3092    24  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3095    47  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3096    68  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3081    45  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3082    41  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3083    21  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3085    29  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3086    21  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3087    33  0 (Unformatted)   503 (IDDCH_DCM1)

[phnxrc@phoncsc ~]$ dlist -f $STANDALONE_DISK/junkdata/rc-0320828-DC.W-0.prdf
Packet   3154    29  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3156    22  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3157    20  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3158    22  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3160    20  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3145   259  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3148    22  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3149    20  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3150    79  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3137    20  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3138    20  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3139    33  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3140    31  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3143    43  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3132    25  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3134    32  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3135    44  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3136    21  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3122    26  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3123    23  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3124    20  0 (Unformatted)   503 (IDDCH_DCM1)
Packet   3125   295  0 (Unformatted)   503 (IDDCH_DCM1)
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Conclusions

- Most of the tasks were successfully finished during this summer repair. We did our best by fixing high voltage problems.
- There is still an unclear situation with 2 big packet sizes.
- HV should be tested in working gas before Run 11.

- Restoration of identical HV regimes in all sectors will need an additional software work to eliminate “regions” that were induced to separate calibrations in weak sectors.
- As part of the normal set up for the upcoming Run, a leak rate test should be performed.